

# Contents

<b>Preface</b>	vii
<b>1. Introduction</b>	1
1.1 A Brief Description of the Internet	1
1.2 World Wide Web	2
1.2.1 HyperText Markup Language	2
1.2.2 Universal Resource Locator	3
1.2.3 Web Browsers and Web Servers	4
1.3 Overview of Web-Based Laboratories	5
1.3.1 The Internet for Education	5
1.3.2 Web-Based Laboratories	8
1.4 Target of the Book	9
1.4.1 Web-Based Laboratories at National University of Singapore	9
1.4.2 Coupled-Tank Experiment	10
1.4.3 Helicopter Experiment	12
1.4.4 Oscilloscope Experiment	13
1.4.5 Frequency Modulation Experiment	14

x Contents

1.4.6 Hardware Structure . . . . .	15
1.4.7 Software Structure . . . . .	17
1.5 Organization of the Book . . . . .	19
<b>2. Server and Client . . . . .</b>	<b>21</b>
2.1 Introduction . . . . .	21
2.2 Network Programming . . . . .	23
2.2.1 Protocols . . . . .	23
2.2.2 IP Address . . . . .	27
2.2.3 Port Numbers . . . . .	28
2.2.4 Socket Pairs . . . . .	29
2.3 Double Client/Server Structure . . . . .	31
2.3.1 Client . . . . .	31
2.3.2 Server Entity in the Web Server . . . . .	32
2.3.3 Client Entity in the Web Server . . . . .	34
2.3.4 Controller . . . . .	35
2.4 Single Client/Server Structure . . . . .	37
<b>3. Client GUI Design . . . . .</b>	<b>39</b>
3.1 Introduction . . . . .	39
3.2 Frequency Modulation Experiment . . . . .	41
3.2.1 Circuit Board . . . . .	41
3.2.2 Spectrum Analyzer . . . . .	43
3.2.3 Frequency Counter . . . . .	45
3.2.4 Signal Generator . . . . .	46
3.2.5 Voltmeter . . . . .	47

3.3 Java and OOP . . . . .	47
3.3.1 Java Applet . . . . .	47
3.3.2 Class . . . . .	48
3.3.3 Class Creation . . . . .	50
<b>4. Components . . . . .</b>	<b>51</b>
4.1 Introduction . . . . .	51
4.2 ImgButton Class . . . . .	52
4.2.1 Class Definition and Constructor . . . . .	53
4.2.2 <code>initImage()</code> Method . . . . .	54
4.2.3 Other Methods . . . . .	55
4.3 Knob Class . . . . .	56
4.3.1 Class Definition and Constructor . . . . .	56
4.3.2 <code>initImage()</code> Method . . . . .	59
4.3.3 Other Methods . . . . .	60
4.4 Connector Class . . . . .	61
4.4.1 Class Definition and Constructor . . . . .	61
4.4.2 <code>initImage()</code> Method . . . . .	65
4.4.3 Other Methods . . . . .	65
4.5 DataDisplay Class . . . . .	67
4.5.1 Class Definition and Constructor . . . . .	68
4.5.2 Other Methods . . . . .	69
<b>5. Panels . . . . .</b>	<b>71</b>
5.1 Introduction . . . . .	71
5.2 Classes for Device Canvases . . . . .	71

5.2.1	Class Definition and Variables . . . . .	71
5.2.2	Constructor . . . . .	73
5.2.3	<code>initImage()</code> and Other Display Methods . . . . .	76
5.2.4	Methods for Client/Server Communications . . . . .	77
5.2.5	Methods for Instrument Handling . . . . .	79
5.2.6	Methods for Switching the Instrument on and off . . . . .	79
5.2.7	Methods for Connectors . . . . .	81
5.2.8	<code>update()</code> and <code>paint()</code> Methods . . . . .	82
5.3	Classes for Devices . . . . .	82
5.3.1	Class Definition and Variables . . . . .	84
5.3.2	Overriding the <code>init()</code> Method . . . . .	85
5.3.3	Methods for Detecting the Mouse over Controls . . . . .	87
5.3.4	Methods for Mouse Movement and Dragging . . . . .	91
5.3.5	Methods for Mouse Events . . . . .	94
<b>6.</b>	<b>Interface Cards . . . . .</b>	<b>97</b>
6.1	Introduction . . . . .	97
6.2	LabVIEW . . . . .	98
6.2.1	Front Panel . . . . .	99
6.2.2	Block Diagram . . . . .	100
6.2.3	Subprogram . . . . .	103
6.3	General-Purpose Interface Bus . . . . .	103
6.3.1	Data Transfer Signals . . . . .	103
6.3.2	Network Topology . . . . .	104
6.3.3	Examples of GPIB Instruments . . . . .	105

6.3.4 Controlling GPIB Instruments . . . . .	107
6.4 Data Acquisition Card . . . . .	113
6.4.1 Drivers . . . . .	114
6.4.2 Controlling Card . . . . .	115
6.5 Digital Signal Processing Card . . . . .	117
<b>7. Audio and Video . . . . .</b>	<b>119</b>
7.1 Audio/Video Server . . . . .	119
7.1.1 H.323 Protocol . . . . .	119
7.1.2 H.323 Architecture . . . . .	121
7.2 Microsoft NetMeeting . . . . .	123
7.2.1 Server and Client Setup . . . . .	124
7.2.2 Active X Control . . . . .	127
7.3 Camera Control . . . . .	131
7.3.1 Client . . . . .	132
7.3.2 Server . . . . .	136
<b>8. Controlling Physical Systems . . . . .</b>	<b>147</b>
8.1 Introduction . . . . .	147
8.1.1 Mathematical Model . . . . .	147
8.1.2 Control System . . . . .	148
8.2 Modeling of the Coupled Tank Apparatus . . . . .	149
8.3 Control Algorithms . . . . .	151
8.3.1 Manual Control . . . . .	151
8.3.2 PID Control . . . . .	152
8.3.3 General State-Space Control . . . . .	154

8.3.4 Fuzzy Knowledge-Based Control . . . . .	154
8.4 Controlling the Coupled Tank . . . . .	158
8.4.1 VI Programs . . . . .	158
8.4.2 MATLAB Script . . . . .	162
<b>9. Multicast Design . . . . .</b>	<b>167</b>
9.1 Introduction . . . . .	167
9.2 IP Multicast . . . . .	169
9.2.1 Multicast Protocols . . . . .	169
9.2.2 Multicast Groups . . . . .	169
9.2.3 Time-to-Live . . . . .	170
9.2.4 Internet Group Management Protocol . . . . .	171
9.2.5 Developing Multicast Groups . . . . .	172
9.3 System Architecture . . . . .	173
9.3.1 Hardware . . . . .	173
9.3.2 Software . . . . .	173
9.3.3 Double Client/Server Mode . . . . .	174
9.4 System Implementation . . . . .	175
9.4.1 User Authentication . . . . .	175
9.4.2 Real-Time Transfer of Spectrum Analyzer Display . . . . .	178
9.4.3 Real-Time Transfer of Command Strings . . . . .	180
<b>10. An Implementation Example . . . . .</b>	<b>183</b>
10.1 Introduction . . . . .	183
10.2 Camera Control Subsystem . . . . .	184
10.3 Video Transmission Subsystem . . . . .	185

10.4 Client Interface . . . . .	185
10.4.1 index.htm . . . . .	187
10.4.2 doexp.htm . . . . .	187
10.4.3 exp1.htm . . . . .	188
10.4.4 exp2.htm, exp3.htm, and exp4.htm . . . . .	190
10.4.5 manualcontrol.java . . . . .	190
10.4.6 pidcontrol.java, generalcontrol.java, and fuzzycontrol.java . . . . .	192
10.4.7 NetMeeting . . . . .	193
10.5 Coupled-Tank Control and Algorithm . . . . .	193
10.5.1 exp1.htm . . . . .	194
10.5.2 doexp.vi and control.vi . . . . .	195
10.5.3 fuzzycontrol.m . . . . .	199
10.5.4 generalpre.m and generalnopre.m . . . . .	200
<b>Appendix A. Source Codes for Camera Control . . . . .</b>	<b>201</b>
A.1 camera_control_console.vbp . . . . .	201
A.2 MainForm.frm . . . . .	202
<b>Appendix B. Source Codes for Interface Design . . . . .</b>	<b>207</b>
B.1 index.htm . . . . .	207
B.2 doexp.htm . . . . .	209
B.3 exp1.htm . . . . .	211
B.4 exp2.htm . . . . .	216
B.5 exp3.htm . . . . .	220

B.6	exp4.htm . . . . .	225
B.7	manualcontrol.java . . . . .	230
B.8	pidcontrol.java . . . . .	242
B.9	generalcontrol.java . . . . .	253
B.10	fuzzycontrol.java . . . . .	262
<b>Appendix C. Source Codes for Coupled-Tank Control . . . . .</b>		<b>289</b>
C.1	fuzzycontrol.m . . . . .	289
C.2	generalpre.m . . . . .	292
C.3	generalnopre.m . . . . .	293
<b>References . . . . .</b>		<b>295</b>
<b>Index . . . . .</b>		<b>299</b>





<http://www.springer.com/978-1-85233-837-4>

Creating Web-based Laboratories

Ko, C.C.; Chen, B.M.; Chen, J.

2004, XVI, 300 p., Hardcover

ISBN: 978-1-85233-837-4